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AUTHOR	Bryant-Jones, Marian; Shimmins, Kymberley J.; Vega, Jill D.
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ABSTRACT

This report describes a program for increasing math achievement through the use of musical interventions including repeated exposure to Mozart classical music and School House Rock, and introduction to teacher-made songs that introduce mathematical concepts in the music classroom. The students of the targeted second and fourth grade classes exhibited low levels of achievement according to local and national standards. Evidence for the existence of the problem included teacher- made pre-tests, parent questionnaires, and student questionnaires. Probable causes for low levels of student mathematical achievement were identified through a review of the literature and analysis of the setting and can be divided into student, home, school, teacher, and district influences. The following probable causes were cited: disabilities, classroom climate, motivation, problem behaviors, lack of homework support due to lack of math competency, home-based factors, lack of professional training and frequent staff turnover, and low contact time in the arts due to funding problems. The solution strategy involved a review of current educational literature with analysis of problem setting, resulting in exposure to music of Mozart, School House Rock, and teacher-made songs that prepared and motivated students while implementing mathematical concepts. Post intervention data indicated a significant increase in students' mathematics achievement in the targeted skills for both second and fourth grades, including students with disabilities. Motivation and classroom climate were also noted. (Author)

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INCREASING MATH ACHIEVEMENT THROUGH USE OF MUSIC

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Marian Bryant-Jones
Kymberley J. Shimmins
Jill D. Vega

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SIGNATURE PAGE

This project was approved by

Prudence J. Court

Advisor

William Cranwell

Advisor

Beverly Gulley

Dean, School of Education

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CHAPTER 1

PROBLEM STATEMENT AND CONTENT

General Statement of the Problem

The students of the targeted second and fourth grade classes exhibited low mathematics achievement scores, which interfered with academic growth. Evidence for the existence of the problem included scores taken from teacher records and district-wide quarterly assessments. A significant majority of students did not understand concepts appropriate to their grade level as reflected on the quarterly assessment reports.

Immediate Problem Context

The school cited had a student population of 266 students. There are many issues that hinder the academic success of the cited school's students. The following gives specific statistics for the cited school. Student gender was 48% female and 52% male. Student ethnicity was the following: 48.1% Caucasian, 39.8% African American, 11.3% Hispanic, and 0.8% Asian as compared to district ethnicity reflecting: 51.0% Caucasian, 31.1% African American, 14.5% Hispanic, 3.1% Asian, and 0.2% Native American students. Eighty-nine point eight percent of students received free or reduced lunches while the cited district percentage was 53.3%. Student mobility, the number of times students enroll or leave a school during the school year, was 16% while the district mobility rate was 16.6%. Attendance rate for the cited school was 93% contrasting the district rate of 91.8%. Chronic truancy rate, the number of students who were absent from school without valid cause for 18 or more of the last 180 school days, was 2%. Two

students were retained in the 2000-2001 school year. In-school suspensions totaled 10 while out-of-school suspensions totaled 36.

The professional staff for the cited school is highly educated and has many classes preparing them for the task of educating the cited school's children. The staff achieved 100% parental contact while the district maintained 99.5%. Staff stability rate was 80%. The ethnicity of the professional staff was 8.3% African American and 91.7% Caucasian. The educational experience of the certified staff included 33.3% Bachelor Degrees, 4.2% Bachelor Degrees plus 10 graduate hours, 4.2% Bachelor Degrees plus 20 graduate hours, 45.8% Master Degrees, and 12.5% Master Degrees plus 40 graduate hours. The staff frequently volunteered to supervise extracurricular activities. Teachers also participated in staff development activities and after-school tutoring (School Report Card, 2000-2001).

The school consisted of two all-day kindergartens, three first grades, two second grades, two third grades, two fourth grades, two fifth grades, and one self-contained cross categorical (second through fifth grades) class. The reading program implemented by the cited school was Success For All (SFA), a Johns Hopkins program. Success For All was a reading program based on research and cooperative learning strategies used in 1800 elementary schools in 48 states within the United States. The program was curriculum driven with a focus on structure instead of instructional processes. In order to reform the process of teaching reading the entire school needed to be involved in the process. The Success For All program was supported by educators because it is a curriculum that raised achievement scores in reading. It was supported by grants, loans from charitable foundations, and government agencies.

The school also utilized Reading Recovery and Title I Resource programs. Reading Recovery is a process utilizing individualized tutoring for 20 minutes daily in order to improve

reading achievement. Title I, a government funded grant for low socio-economic schools, focuses on improving mathematics and reading achievement. A homework policy was implemented in the 2001-2002 school year requiring all students to complete 10 to 20 minutes of nightly homework each Monday through Thursday. Students were given a Homework-Assignments-Missing (HAM) sheet if they did not complete the nightly assigned work. Students must respond with a reason for missing the assignment and a plan to complete the homework in a timely manner. The HAM form must be signed by the parent and returned with the completed homework. Administration was responsible for implementing requirements of the homework policy by assigning after-school detention to ensure that the homework was completed.

Everyday Math, a spiraling program, was implemented throughout the cited building. Students in first through fifth grades received one hour of mathematics instruction each day for five days of the week. There were several components of the Everyday Math program, including math message, five-minute math, whole group activity, small group activity, math boxes (independent seat work), skills link (homework), and study link (extension activities).

A typical mathematics lesson would begin with a five-minute review of previous skills and facts using dry erase boards or the chalkboard. The teacher then initiated direct instruction covering the assigned topic as a whole group activity. The students in each class were assigned to cooperative learning groups to accommodate various activities. In those cooperative groups, the students practiced the skills taught. The students then went to work independently where they completed the assignments given. The students worked on previously learned skills and pre-viewed upcoming skills. Nightly homework and the use of supplemental materials reinforced skills. Due to the lack of repetition required, the program failed to give students adequate time to master concepts. The drawback of the Everyday Math program was that it

failed to allow the student the opportunity to master one concept before moving on to a different concept. Instruction of a new concept may continue only two to three days before introducing on to a new concept. Review of the concept was briefly practiced at a later time. The school cited district discouraged use of supplementary materials.

Students at the school received art, music, and physical education one to two times per week for each subject. Due to scheduling conflicts, each class did not receive the same amount of music, art, and physical education per week. The length of specialist classes was 30 minutes for music and physical education and 40 minutes for art. The physical education teacher taught five days per week. On the lesser side, the music and art teachers conducted classes at the cited school for only three days per week. Both music and art specialists taught at other schools within the same district. All classes in the cited school also performed in music programs twice yearly. While this was a positive activity for school environment, practices for special performances during the weekly music classes reduced the amount of time devoted to the music curriculum. Many of the music curriculum state objectives were closely related to similar skills in the mathematics program, such as fractions and note duration, recognition and performing of patterns, meter and time division, note groupings and multiplication, measures and addition.

The Surrounding Community

The school cited was located in a mid-western city with a population of 150,115 and a school enrollment of over 27,000 students. The school district served residents in an area covering approximately 170 square miles. The district operated 41 elementary schools, 6 middle schools, and 6 high schools (2001 Rockford Public School District Directory, 2001). District board members were divided on views of how to manage district affairs resulting in frequent physical altercations (Register Star, 1999, 2000, 2001).

The school district was recently released from a court ordered desegregation lawsuit. The 1989 lawsuit was filed by a group of citizens who protested the closing of a number of west-side schools located in many minority neighborhoods. A trial was held in U.S. Federal District Court in 1993 to decide if the school district discriminated against African-American and Hispanic students. In 1994, U.S. Judge Stanley J. Roszkowski found the district guilty on 11 counts of willful discrimination. The Judge ordered the school district to implement remedies to eliminate discrimination against minority students and provide an equitable education for all students. As a result, a Comprehensive Remedial Order (CRO) was formulated to undo the harm previously afflicted on cited district students. In October 1995, the board of education for the cited district voted in favor of a controlled choice desegregation plan, which was ordered by Judge Mahoney in 1996. Construction of two grade schools and a middle school was also ordered. In 2000, the federal magistrate held unitary status hearings to determine if court control was still needed. Court order remained until 2001 when the U.S. Court of Appeals ruled that the district had complied with all court orders and could be released (2000-2001 Rockford Public School District Profile Internet Home Page, Strategic Plan).

Following years of legal and consultant fees and expenses resulting from discrimination and the CRO, the district was on the verge of financial bankruptcy and proposed closing several schools along with major budget cuts (proposed $21,889,637) which affected students, certified staff, and administration. The district was involved in a three-year process of paying back property taxes to the district's taxpayers in response to the court ordering a Protest Tax Settlement in the amount of $9,700,000 for illegal taxation during the years of the desegregation lawsuit. The district asked taxpayers to vote for two referenda requesting permission to raise taxes in 2001 and to sell bonds to increase district income in 2002 (M. Bushaw, personal

communication, Feb 28, 2002). Many programs and positions were cited for reduction to meet the needs of the struggling district. The instructional expenditure per child was $4,848 during the 1999-00 school year compared to an average state amount of $4,425. The operating expenditure per district pupil was $8,655 in the 1999-00 school year compared to $7,483 per student in districts within the same state (Northern Illinois Business and Industry Data Center, 2000).

The occupational breakdown for the community workforce was as follows: 4.2% construction/mining, 28.9% manufacturing, 5.1% transportation/communications/utilities, 4.6% wholesale trade, 16.4% retail trade, 4.2% finance/insurance/real estate, 26.5% services, and 10.1% government. The city cited was a region with large numbers of manufacturing and service employees (City of Rockford, 2001).

Migration out of the city for all socio-economic classes increased from approximately 12,400 in 1995 to 13,295 in 1999. Migration into the city decreased from approximately 13,000 in 1995 to slightly above 12,000 in 1997 increasing once again to 13,048 in 1999 (Northern Illinois Business and Industry Data Center, 2000). The cited school is located in a city that has struggled with many concerns, economics, high taxes, unemployment, crime, and social issues. The median income was $36,745 falling to the 39th percentile within the state (iPlace, Inc., 2001). Taxes were $5.5310 per $100.00 (S. Connell, personal communication, March 11, 2002). On the positive side, housing was affordable with the mean value of a home listed at $74,145. Owner occupied housing was 71.7% of the housing (U.S. Census Bureau, 1999). Unemployment in the state was 4.3% in 1999 with the cited city having 4.5% unemployment. The crime index in 2001 ranked the cited city at the 40th percentile in the state and the 5th percentile nationally (iPlace, Inc., 2001). Socially, the mode age for the cited city was 25 to 34

years old. Families headed by single females with children were 9.8% in 2000 (U.S. Census Bureau, 2000).

National Context of the Problem

According to Sander (2001), "Former United States Secretary of Education once called Chicago's Public School System the worst in America." (p.27) Test scores and high school graduation rates determined the quality of education in Chicago Public Schools. Students in Chicago placed in the bottom 10% nationally on the American College Testing (ACT) scores. Approximately one half of high school students dropped out prior to graduation.

In a study by McNeil (2000), the Texas Public Schools implemented an accountability system in response to low achievement. Fewer than 60% of Latino students and African-American students graduated from high school. Many students were retained in ninth grade more than one year in response to massive failures reflected in the Texas Assessment of Academic Skills (TAAS) scores.

In South Carolina, students were given a year-to-year Basic Skills Assessment Test (BSAP). Over the past 10 years, students' mathematics achievement scores fell from 70.7% to 65% for eighth grade students. In mathematics, students' scores decreased from 84.8% in third grade to 65% in eighth grade. In the tenth grade, only 65% of testers passed the tenth grade exit exam required to receive a high school diploma. "South Carolina's 1999 average composite SAT score of 954 was the lowest in the nation, despite a three point increase" (Fix, 1999).

The widespread problem of low mathematics achievement scores was also prevalent in California. "Math scores... were down in virtually every grade" (Jacobs, 2002, p.44). At a charter school cited, only 32% of students met district expectations, down from 42% from

previous years.

Low mathematics achievement also affected universities and continuing education. Students successfully completed high school, but frequently needed remedial education across the country. "A large number of entering college students are not prepared for college-level course work" (Hoyt, 2001). Ponessa stated (as quoted by Hoyt and Sorensen, 2001), "Students have gone through high school mathematics classes without gaining a real understanding of the subject matter." (p.27)

Badian (1999) stated, "...the percentage of a total school population in the northeastern United States in grades 1 to 8 who scored at or below the 20th percentile of a composite measure including computation, numerical concepts, and verbal problem-solving."(p.46) Badian then discussed research by Share, Moffitt, and Silva (1988) that gave tests to 459 New Zealand 11-year olds followed from birth. Share et al. (1988) reported that 8.5 % were low in both arithmetic and reading. Students also showed an arithmetic disability rate of 6.5% with 15% of students in the study performing poorly in arithmetic. In the study by Badian (1999), 6.9% were low achievers in arithmetic. In the article regarding persistent arithmetic and reading disabilities, Badian (1999) discussed mathematics achievement, saying, "...poor achievement in mathematics stigmatizes a child and, like a reading disability, contributes to feelings of low self-esteem." (p.45) The researcher also stated, "...mathematical competency is important for many basic aspects of adult daily life such as telling time, counting change, planning within a time frame, and balancing a checkbook." (p.45)

Nationally, researchers are also concerned about the achievement gap that divides low-income and minority youngsters exhibited when compared to more affluent students. In a study by Haycock (2001), data was taken from the National Center for Education Statistics (NCES)

and the National Assessment of Education Progress (NAEP), as well as from state and local school districts. According to Haycock:

> About 1 in 30 Latinos and 1 in 100 African Americans can comfortably do multi-step problem solving and elementary algebra, compared to 1 in 10 white students. Only 3 in 10 African American and 4 in 10 Latino 17-year-olds have mastered the usage and computation of fractions, commonly used percents and averages, compared to 7 in 10 white students. (p. 7)

Kentucky, thus, became the first state to embrace state standards-based reform using learning goals and insisting that even the poorest students would meet set goals.

Just as the cited school, Kentucky (Haycock, 2001) gave extra funds to extend instruction in ways that worked best for their area. Instruction time was added before and after school, on weekends, and summers. San Diego tripled that amount of instructional time for literacy and mathematics to counteract low-performance. El Paso, Texas, invested funds and increased training time for new teachers in the areas of mathematics and science in hopes of preparing teachers to implement programs targeting higher student testing results.

President George W. Bush (2000), then Governor of Texas, published results of mathematics and reading achievement scores. Texas was a state with previously high numbers of low achieving students in mathematics and reading. According to the RAND study, educational reform raised scores to second nationally among the states. President Bush stated, "...disadvantaged children (have been) left behind by failed schools. The diminished hopes of our current system are sad and serious - the soft bigotry of low expectations." (p. 125) President Bush continues, "We must also raise the academic ambitions of every public school in America - creating a culture of achievement." (p.125)

Low mathematics achievement scores and low academic growth are a national problem. The goal of the researchers was to find a factor that would eliminate or change the issues that are negatively influencing achievement scores and academic growth. All educators need to work together, regardless of teaching assignment and help bridge the learning gaps in mathematics and focus on learning concept deficiencies. Teaching professionals need to help students develop computational, numerical, and verbal problem solving skills, in order to help students excel, as in mathematics in the case of the researchers within this study.

CHAPTER 2

PROBLEM DOCUMENTATION

Problem Evidence

In order to document that second- and fourth-grade classes showed low scores for math achievement, the researchers examined data from pre-tests, used as baseline data. Parent questionnaires and student questionnaires were also given to establish a lack of mathematical competency and support by parents. Through the use of student questionnaires, the researchers wanted to show lack of mathematical experiences in the student home environment. Pre-tests administered before the implementation and intervention showed low math achievement scores on math concepts appropriate for their grade level.

Baseline data, taken from a test covering general math skills, was collected from 16 second-grade students (Appendix A) and 16 fourth-grade students. Baseline data for second-grade students are listed in Figure 1. Scores for second-grade students had a large range of 56 percentage points. Scores ranged from 24% to 72%. The lowest two scores, 24% and 28%, were from students with learning disabilities. The mean for the targeted second-grade students was 53.9%. For the same group, the mode was 52% and median was also 52%. Surprisingly, there were nine students who scored between 40% and 60%. A score of 80% was the lowest score to meet standards at the school cited. This group did not have any scores of 80% or above.

Baseline data for targeted fourth-grade students (Appendix B) are listed in Figure 2. Scores for fourth-grade students covered a range of 75 percentage points. The range of scores, from 25% to 100%, was larger than the range for the second-grade students in the study. The

lowest three scores, 25%, 35%, and 35%, were from students with learning disabilities. The highest two scores, 95% and 100%, were recorded by students who were recommended for the gifted program. The mean for the targeted fourth-grade students was 62.19%. For the same group, the mode and median were both 65%. There were nine students who scored between 60% and 80%. As with the second-grade group, a score of 80% was the lowest score for meeting standards. This group had three students that met or exceeded benchmarks for the mathematics curriculum.

The characteristics of the targeted classes were similar in size and ability. There were sixteen students tested in each class. Both groups had two students with learning disabilities in reading and math as a result of physical and/or developmental delays. Overall, the fourth-grade group being studied had higher scores for math achievement when compared to the baseline data of the second-grade group.

The baseline pre-tests contained items addressing mathematics concepts from previous grade levels. The second-grade group had less of an advantage because the skills being tested in the pre-test were based on one to two years of math instruction. Some of the concepts on the fourth-grade pre-test were skills that had been presented and reviewed during three to four years of math instruction. Due to the familiarity or repetition of the mathematical concepts, the older group may have performed higher on the pre-test. The second-grade students had less mathematical experience and many concepts may have seemed new or unfamiliar if an understanding of the concepts was not reached the previous year.

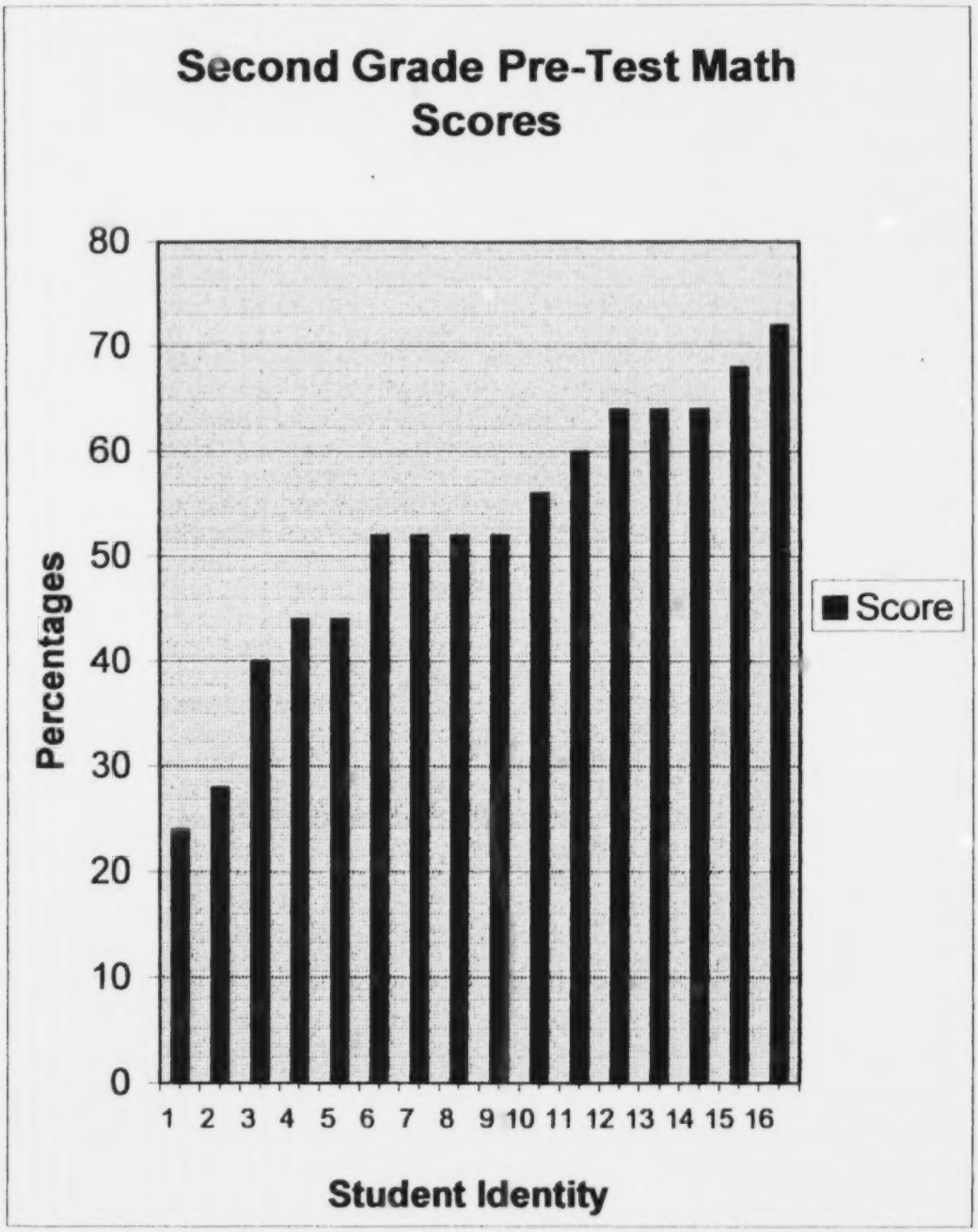

Figure 1. Figure representing pretest scores for second grade students.

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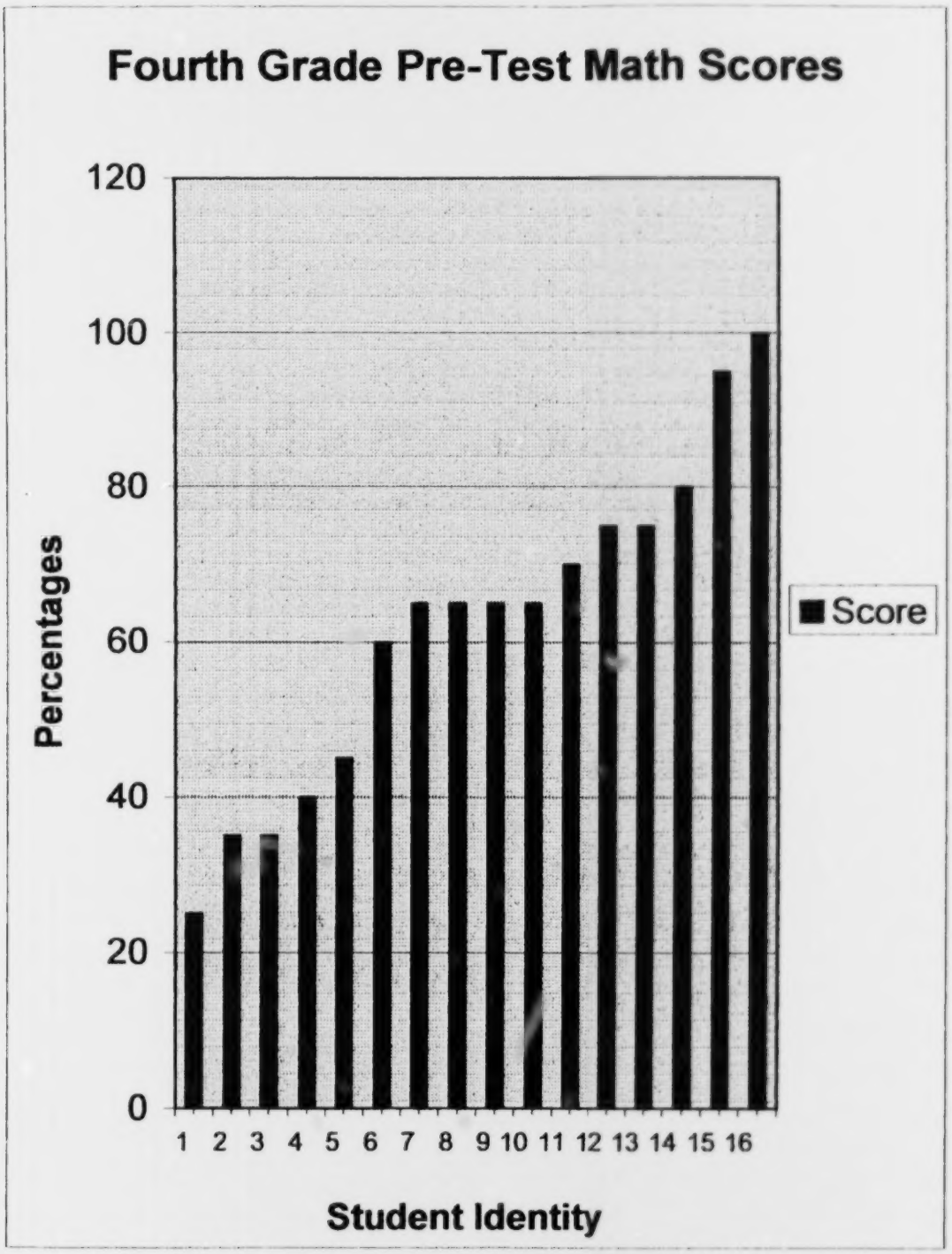

Figure 2. Figure representing pretest scores for fourth grade students.

One point of interest is that many of the fourth-grade students, while in second grade received instruction by the same researcher who conducted the second-grade pre-test in this study. Another connection noted by the researchers was that at least two of the students in the second-grade group were siblings of students in the fourth-grade group. Many of the students were inter-related, by genetics or by marriage. Some of the students were cousins, half-brothers, or siblings to children in the other group. These researchers believed that the majority of the parents were not supportive or competent to assist students in increasing their understanding and achievement of mathematics. In the parent questionnaire (Appendix C), 38% of the parents of second graders indicated that they felt that addition and subtraction were their highest level of competency (Figure 3). A large number, 37.5% of the parents of the second-grade group, felt that multiplication was the highest level of support to which they could give assistance to their children (Figure 4).

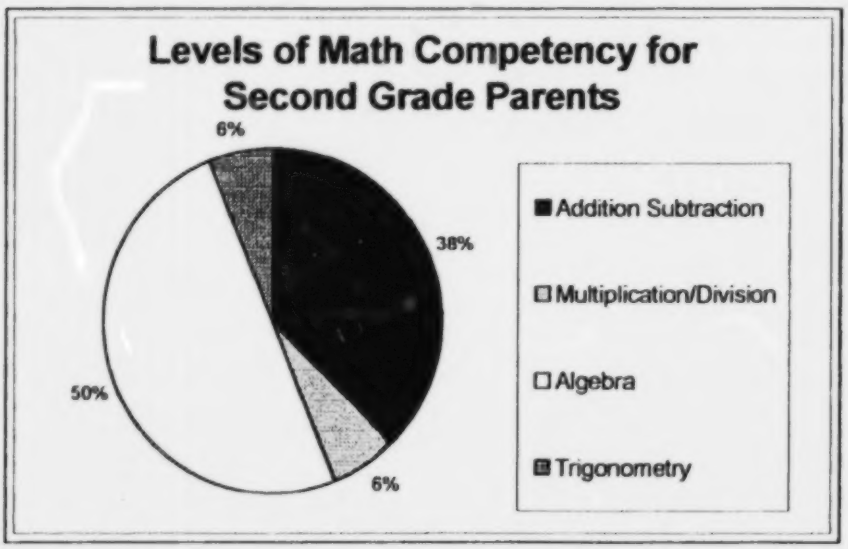

Figure 3. Figures representing math competency for second grade parents.

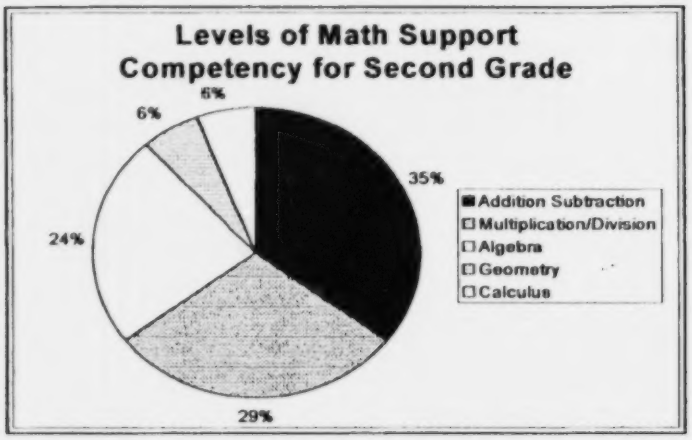

Figure 4. Figures representing support competency for second grade parents.

Fourth grade parents seemed more confident in their math skills. Thirty-five percent of the parents responded in the parent questionnaire that they were comfortable with algebra as their highest level of competency (Figure 5). However, when asked to assist their child with mathematics homework, only 47% felt comfortable assisting their child in multiplication/division (Figure 6).

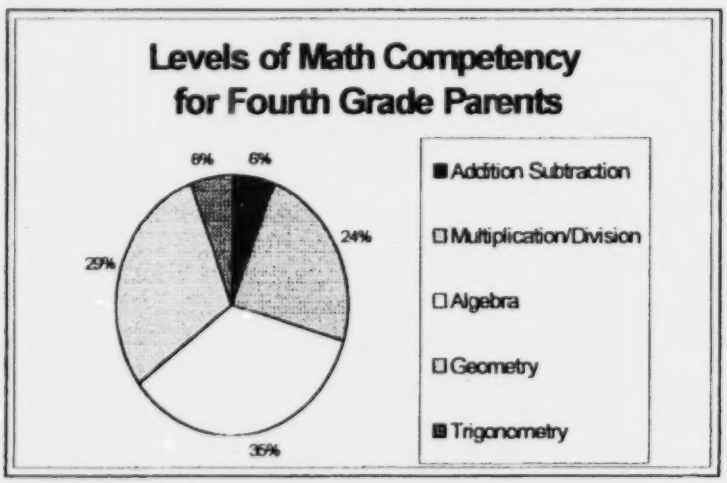

Figure 5. Figures representing math competency for fourth grade parents.

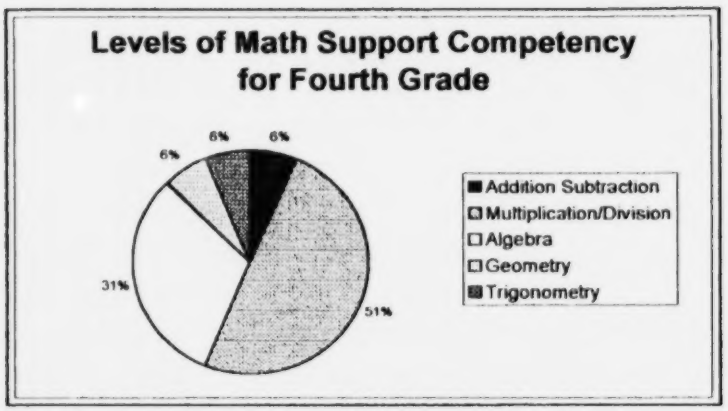

Figure 6. Figures representing support competency for fourth grade parents.

In the student questionnaire (Appendix D), a majority of second- and fourth-grade students indicated in questions 1 and 2, that they enjoyed mathematics and playing math games. Most students, 13 out of 15 in the second grade and 11 out of 18 in the fourth grade, did not work with their parents on math activities at home. Both groups overwhelmingly stated that they enjoyed creating designs with shapes. Most students also felt capable of counting change correctly.

Probable Causes

The following are probable causes that are within the cited school. The school had an extremely large student population with a low socioeconomic status. The number of students who received free or reduced lunch, defined as poverty level, was 89.8%. Single females, extended families, or foster parents headed the homes of a large percentage of the student population. Many students came to school hungry and/or dirty. The majority of students' families qualified for or received welfare benefits. Due to the lack of district funding, the cited school building was in great need of repair/replacement, causing low student and staff morale.

There was a high mobility rate due to the number of students transferring to and from other cities and states. Many parents of the students attending the cited school were uneducated and unsupportive. There was a large turnover of five out of thirteen certified classroom teachers and an administrative staff position as a result of negative views of the community surrounding the cited school.

The school had a large enrollment of students with chronic problems. With numerous mentally impaired students attending the regular education classroom, a large amount of repetition was required to master basic concepts. Emotionally disturbed children interacted negatively with the regular classroom students. Students were witnessed throwing chairs, spitting, swearing, and fighting with peers and teachers. Counseling was not available due to funding problems. No outside or community mentors would come to the school due to extreme student behaviors. A supportive partnership of mentors from a local company declined to return due to extreme behaviors exhibited by numerous students. A lack of qualified paraprofessionals available to work with problem students made the situation even worse because classroom teachers did not have adequately trained, mature adult support to continue the teaching process without interruptions from needy students. A large number of learning-disabled students did not receive resource assistance in the regular classrooms due to significant changes in the federal guidelines for eligibility. A large number of students, with behavior-disorder eligibilities guided by Behavior Management Programs were mainstreamed into regular education classrooms. Many of these students exhibited negative or aggressive behaviors making the learning climate undesirable. In several instances, records were not received in a timely manner for students transferring into the school district. As a result, students with learning disabilities were not identified for up to a semester. The records were requested from other states and cities, but they

were not made available. Students at the cited school consistently achieved low scores on state and district mandated benchmarks.

The school had concerns about the curriculum. There was not enough money allotted to buy needed materials to supplement the curriculum. There was a limited supply of materials to implement hands-on activities, which were integral to the curriculum. Math carts with materials were often depleted of the needed items necessary for the entire program.

The school implemented the Everyday Math Program. The pace of the program was too fast for struggling students. The program did not call for the mastery of any one skill before progressing to another concept or skill. There was not enough repetition of previous skills, nor was there enough focus on application of skills. Given the allotted direct instruction time available, it was difficult for teachers to meet the required hour per day needed to implement Everyday Math properly. Due to scheduling issues, there was no flexibility with the curriculum. Teachers were not thoroughly prepared to implement the new math program. The supporting Everyday Math website, which was supplemental to the curriculum, was frequently unavailable due to technical difficulties.

There was only one 30-minute session per week allotted for music class, which decreased student exposure to patterning and time duration (note length). These are concepts that strengthen math skills. The researchers believed that the limited amount of music exposure did not allow time for the music teacher to implement strategies that would increase math achievement. In order to deliver these strategies to aide in mathematics, the music specialist would have to focus less on the traditional curriculum and integrate mathematics and music given the 30-minute time allotted per week for the music curriculum.

Only two 30-minute sessions per week were allotted for physical education, which made extremely active children agitated due to need for more movement. There was only one 45-minute session per week allotted for art, which limited student exposure to patterns and geometrical shape manipulation, which are also foundations for math achievement.

The literature reflects similar probable causes for low math achievement in a national context. High levels of poverty contributed to low achievement scores. Students had low math achievement due to low economic status (Johnson, 1999). High school dropout rates were related to family income. The poorer the family was, the more likely it was that the student would dropout (Freeman, 1995). Johnson's study shows that wealthy students in Catholic schools outperformed poverty-stricken public schools in math achievement scores (Johnson, 1999). Students with impoverished diets who suffered from iron deficiencies tended to score much lower in math than students with regular iron levels (Halterman, 2001). Students from economically depressed urban areas faced many obstacles in education because of inadequate funding and lack of educational quality and opportunities (Zwick, 2001). Fetler suggested that poverty had a great affect on student achievement (Fetler, 2001).

Teachers entered the teaching field under-prepared to handle real life situations in the classroom. Teachers lacked proper training in implementing the curriculum properly. "Learning mathematics is threatening to most teachers, especially elementary teachers whose limited experiences with mathematics have been anxiety-provoking and uninspiring" (Barnes & Paterson & Barnes, 1996). Teachers needed to become skilled at identifying and addressing individualized learning problems of their students. Educators also needed to intrapersonally reflect on their own teaching practices, as well as on student evaluation. (Stansbury & Zimmerman, 2000).

Many teachers evoked feelings of uncertainty when developing unfamiliar leadership roles required to acquire new skills and abilities (Barnes & Paterson, 1996). Students felt that teachers did not address their feelings regarding their math achievement and teachers often did not know the subjects that they were teaching. Students felt underrated and under-challenged by some educators (Haycock, 2001).

Teacher roles were undefined and split between education and social work (Forgione, 1998). Despite several years of professional teacher development and the introduction of new best practices, educators did not have a clear idea of what was working and what was not (Holland, 2000). There was a consistent weakness in U.S. teaching performance that became enlarged over the years (Forgione, 1998). Fetler examined the relationship between student dropout rates and faculty characteristics and found a direct relationship between the teacher's experience, preparation and student math achievement (Fetler, 2001).

Curriculum in the United States was weak, especially in the areas of math and science. The United States curriculum is below international standards (Forgione, 1998). Nationally, the United States has poor textbooks in the middle schools and low expectations of students' performance (Moorlehem, 1998). A typical United States eighth-grade math book covered about 35 topics, while a German or Japanese math textbook for the same age group covered only six topics. In other countries, most middle schools shifted their curriculum in the direction of algebra and geometry while the United States did not. Other countries taught students how to use math rather than how to do math (Forgione, 1998). American students felt the curriculum was extremely boring (Haycock, 2001).

Math tests were rarely designed to have real-life applications such as making change for a dollar. Previously, testing math concepts focused on the abstract representation of stimuli and the

responses. Success on a paper/pencil test did not ensure that the child would be able to make change from a purchase (Tanner, 2001). When comparing international test-scores, Bracey states, "American kids get dumber the longer they stay in school" (Bracey, 2000).

Minority and low-income students tended to be low achievers. Low-income and minority students were farther behind academically than all other American students (Haycock, 2001). About 3% of Latinos and 1% of African Americans can comfortably complete multi-step problem solving and elementary algebra, compared to 10% of white students. Thirty percent of African-American 17-year-old students and 40% of Latino seventeen-year-old students commonly used percents, fractions, and averages, compared to 70% of white 17-year-old students. By the end of high school, African-American and Latino students had math skills that were equal to math skills of white students in the eighth grade (Haycock, 2001). Students who took college preparatory math classes were more likely to be successful on standardized tests. Difficult class work challenges the student to excel (Haycock, 2001).

CHAPTER 3

THE SOLUTION STRATEGY

Literature Review

Low math achievement is documented in a wide variety of literature and evidenced in the results of state and national assessments. Researchers cite behavior and classroom climate as factors that prevent students from academically achieving their highest potential. The literature showed that changes in and weakness of the curriculum along with lack of professional training caused teachers to be under-prepared to effectively instruct students. The literature states that many new strategies and educational programs were recommended to narrow the achievement gap. It was believed by the researchers, as cited in this study, that the implementation of the arts, specifically music, would help students raise mathematical achievement scores as well as enhance overall intelligence.

Studies showed that a positive environment would motivate students. Students might utilize self-management techniques such as giving themselves points, self-journaling or reflections, PMI charts evaluating progress of the day, and self-evaluation forms. Students needed to set goals for themselves. It was believed that students should have a choice of instructional settings. Teachers needed to offer rewards, set through use of field trips, good notes home, good calls home, free time, teacher praise, special privileges, and treasure chests, to students who obtained their goals. Teachers needed to provide cooperative learning and problem-solving experiences. Cooperative learning is an educational strategy in which students work in

groups to achieve a common task. Students needed to be taught how to manage their time and pace themselves by setting a schedule, being prepared with materials, and outlining projects. Student's awareness of their own achievement was necessary in order to assess themselves and avoid comparing themselves with others (Renchler, 1992). Activities may have included journaling, syllabuses showing requirements, and rubrics outlining expectations.

Research supported the need for administrators to be supportive of students and provide assistance in increasing motivation. Administrators needed to think of how motivation worked in their own lives and create a positive method of transmitting it to the staff and students. It was noted that administrators needed to be aware of the following:

1. Administrators needed to discover ways to show how motivation played an important part in everyday life.
2. Administrators communicated to students that success was important and rewarded them for all forms of success.
3. Administrators needed to teach parents to work on motivating their child.
4. Staff and administrators needed to show that learning is enjoyable and never ends (Renchler, 1992).

One approach to behavior problems is the Effective Behavioral Support (EBS) Model. Students and teachers learn the definitions of problem behaviors, and positive behavior. Alternative behaviors are taught to students and help is given to acquire the necessary skills for the desired behavior changes. Students are encouraged with incentives and motivational systems. Motivational systems include mini-lessons taught by the teacher to maintain patterns of behavior. Other motivations include posters, school newsletters, and assemblies. Videotaped presentations of behavior lessons are also used. Incentives consist of a system of enforcement, monitoring and positive reinforcement of desired behaviors. Rewards include tokens, tickets, weekly drawings, and rewards for students and teachers. Administrators and teachers are committed to the intervention throughout the school year by monitoring, helping, coaching, and counseling as

needed to reach the achieved goals. Teachers receive training and regular feedback from mentors about the effectiveness of the intervention. A method of measuring and checking the effectiveness of the intervention is established and carried out (Sprague, Walker, Golly, 2001).

Strategies are implemented to help students who make the effort. Students define their own criteria for success with goal setting. Outcome-based instruction allows all students to achieve success without competition. Students set individual goals without competing against higher achieving students. Students need to be taught to view failure as a lack of effort, not ability. They participate in cooperative learning activities in order to realize that personal effort contributed to a group (Raffini, 1998).

Students with high-incidence disabilities (attention deficit/hyperactivity, special learning disabilities, emotional disturbance, mental retardation) benefit from social skills training (Gresham, Sugai, Horner, 2001). Due to the increasingly disruptive learning environment in K-12 schools, a program called Effective Academic and Behavioral Intervention and Supports (EABIS) was developed to support positive teaching and learning environments. It is a model developed to increase the capacity of schools to reduce problem behaviors, thus focusing on the process instead of the final product. (Ohlund & Nelson, 2001). Teachers must restructure the classroom, such as the physical arrangement of the classroom, student seating, oral responses instead of written responses and implementation of cooperative learning to address a diverse student population (Gable, Hendrickson, Tonelson, 2000).

Professional training and curriculum enhancement are necessary components in raising student achievement. Schools in the targeted school district used Title I funds to implement the Success for All (SFA) Reading Program in an effort to ensure that all children learned to read. Success for All uses effective practices for beginning reading. The school and staff were

regularly monitored by SFA facilitators to note progression (Greenlee & Bruner, 2001). Cooperative learning strategies were also used in the SFA Program. Cues were taught for enhancing listening skills to improve mathematics achievement. Educators received invaluable training to implement SFA. That training did not address the area of mathematics.

Other schools implemented strategies to remedy concerns similar to those of the cited school. The Individuals with Disabilities Education Act Amendments (IDEA) require school personnel to write behavior plans with positive strategies and supports. It also requires teachers and other staff to be trained in developing and implementing positive intervention strategies (Reid & Nelson, 2002). On the opposite end of the spectrum, the Edison Project relied on suspension and physical restraints when dealing with at-risk students. Edison, at the time of the research, was our country's leading private manager of public schools, operating under formal management contracts (Farber, 1998).

Nationally, strategies being used to increase math achievement score included outsiders taking over school control and implementing outside curricula. "Educational Management Organizations (EMO's) operated preschool through college and provided a school's curriculum and management" (Furtwengler, 1998). The Edison Project, which operated in private and charter schools across the nation, made gains in reading and math achievement (Farber, 1998). The Edison Project implemented SFA to address reading standards and objectives. The Edison Project implemented by the University of Chicago School Mathematics Project, which was also called the Everyday Math program, was implemented in the cited school. The Edison curriculum included sessions in character education, which taught social skills. Technology was also a major component of the project. Each student in the Edison Program received a home computer (Furtwengler, 1998).

In the Edison Program, various strategies included teachers demonstrating that doing mathematics meant the student could do the math and apply it in many different ways. In educational practices, knowing was neglected and doing was overemphasized (Cawley, 2002). Teachers integrated the curriculum by including writing performance tasks in the math curriculum and using everyday journal writings. It helped to provide the teacher with useful information about the pupil. Another effective strategy for teaching math was ad hoc tutoring. The teacher presented the math lesson and then gave follow-up work to targeted students providing them individual instruction (Woodward, Monre, Baxter, 2001).

In another project, researchers used videos to improve complex math problem solving. Students with learning disabilities were shown real-life videos showing math applications instead of text-based problems. (Bottge, 2001). One researcher used a professional development program that provided effective academic and behavioral interventions, called a Student Evaluation Rubric (SER). It was noted, also, that schools needed to realign the curriculum, change instructional strategies, and accommodate special need students in order to raise mathematic scores on standardized testing (McCown & Runnebaum, 2001). Another researcher found that an aesthetic experience needed to be fostered by a staff that appreciated an arts-based approach. Teachers with less personal experience in the arts were less likely to be successful in implementing an integrated art-based curriculum (Fogg & Smith, 2000). Likewise, instead of focusing on preparation for future performances, music specialists should be focusing on integrating their art form with the general curriculum for academic success. The existing curriculum should be expanded and adapted into a regular subject. The contribution of academic skills taught by art-based teachers and specialist is ignored (Kelstrom, 1998).

Various strategies are implemented for low-achieving students to enhance achievement and increase learning. Schools need to identify at-risk students and pay close attention to low performing students. It was found that low-achieving students must be identified early in the school year so that they can be provided the extra time and extra help that they need. The program must also ensure that the extra time and extra help are benefiting students. Recommendations were to promote all students, but continue tutoring time for those needing extra help. Kelstrom also recommended an enriched curriculum so that students could catch up with their same-age cohorts. This could be achieved by providing lessons that address the multiple intelligences and incorporate games, music, and computer technology.

Recommendations for low-achieving students included keeping the same teacher with a cohort of students for several years, implementing multi-age classrooms to increase learning time for groups of students at the same academic level, and a summer school enrichment program. An open-door policy that encouraged parental participation increased interaction between parents and their children's school. Another strategy created an extended learning opportunity in companies where parents worked requiring joint homework assignments from parents and students.

Low-achieving students benefited from award systems resulting in increased achievement levels. Saturday School or weekend academies, as well as remediation activities involving tutors, increased student achievement. Low-achieving students also benefited from implementation of extended school day programs providing high school students an alternative way to complete requirements for graduation.

Successful Alternative Schooling includes unique educational ideas and settings such as off-campus education and a school within a school. Strategies focus on the objective that at-risk

students have an opportunity to catch up with their peer groups. Some alternative schooling programs provided social and mentoring services to students and their families. Smink found great success when a mentoring scheme was implemented in which students shadowed businessmen so that students could see what business was like and how mathematics was applied in employment (Smink, 2001). Linan-Thompson and Hickman-Davis recommended educators focus short intensive reading programs with high expectations for low-achieving students. Students were pre-tested, participated in an intervention which consisted of skill work, phonemic awareness, spelling and word analysis, which ended with a post-test. Differences between pre-tests and post-tests were quite significant, showing the importance of academic support from the community (Linan-Thompson and Hickman-Davis, 2002).

Researchers suggest that goals set for students must not be too low. To do so, is to set the students up for low achievement. A standard must be set so that everybody can go on to meet or exceed institutional norms. Educators must discontinue low-level courses that award academic credit (Daniel, 2001). Students will not achieve if they do not perceive education as true learning. "Students begin to disengage when they see that schooling is not about their learning, but is about creating the appearance of learning" (McNeil, 2000).

The goal of educators is to keep motivation of students high and develop the cognitive skills of the child in order to increase achievement. Implementation of the Arts has been shown to lead to higher mathematic achievement. The researchers noticed an association between music and math achievement. A close relationship was established between the musical symbolism in time signature and mathematical symbolism in fractional concepts. A physical link was also noted when children exercised neurons during involvement in music. Students enhanced their

intelligence, especially in mathematical capabilities, spatial reasoning skills, and complex reasoning skills (Cheek, 1999).

Other countries (Japan, Hungary, and the Netherlands) found music could increase aptitude and learning success in all areas. Music is a major part of the curriculum in these countries. The United States is far behind these countries. The Japanese found significance in cultural music and uses a great deal of music in their schools. In Japan, the goal of kindergarten education is to help children have positive interactions with their environments. Expression in the Arts is used to integrate children's activities. The curriculum is organized to correlate with these activities (Mori, 1996).

Hungary utilizes an educational theory by the name of Kodaly. Students are expected to aurally know relationships (distances) between pitches and demonstrate this knowledge by use of hand signs. Kodaly theory also utilizes hands-on activities. In Hungary, an important aspect of the program is flexibility in scheduling. If the interrelated components in the Arts called for more time, the daily program was adjusted with permission of the administration. The Kodaly method uses the principle of variation of melodic units. Recognition of music is said to be a pleasure and brought relief (Kokas, 2001).

In Denmark, music education has been formulated through the passing of recent legislation. The Public School Act of 1993 states that music instruction should create guidelines for acquiring knowledge and skills through playing of instruments, dance, movement, and music appreciation. According to Holgersen, music education at the elementary level includes integration of other subjects. Denmark had a long-time tradition of interdisciplinary activities. The Arts and movement were displayed in these interdisciplinary activities. Students receive instruction and group experiences in singing and instrumental music as part of their elementary

curriculum (Holgersen, 1997). Denmark uses integration of music and math to raise student math achievement scores.

Other studies reveal that music instruction actually enhanced student achievement in numerous curriculum areas. The College Board for the Scholastic Aptitude Test (SAT) revealed that music/art students consistently scored significantly higher on the math and verbal sections of this widely given college entrance exam. In several studies, Kelstrom found music and the arts were building blocks of the human intellect leading to academic and career achievement. Students who listened to Mozart for 10 minutes per day had higher spatial scores on an activity than those who did not listen to the music. Likewise, memory training, listening, recall, and concentration are skills in music that transfer to other academic areas. Rhythm, coordination, motor skills, critical thinking, and logic are also developed as a result of music study. Kelstrom found that studying music helped students to learn multiplication and math formulas more easily (Kelstrom, 1998). He also provides found evidence that there is a strong correlation between music instruction (choral, general, or instrumental) and higher grades and/or test scores in mathematics.

Project Objectives and Processes

As a result of increased musical stimulation in the area of mathematical concepts during the period of September 2002 to November 2002, the second- and fourth-grade students will increase their ability to master math concepts as measures by the teacher-made pre- and post-tests.

In order to accomplish the project objective, the following processes are necessary:

1. Students will listen to Mozart daily for 10 minutes to achieve higher spatial scores in symmetry.

2. The music teacher will create songs for second-grade students (to promote two digit by two digit subtraction with regrouping) (Appendix E) and fourth-grade students (to enhance students' retention of geometric forms) (Appendix F).
3. Students will receive instruction in music class in which the teacher will focus on note duration as a way for students to increase their skills with fractions (second grade) and geometric forms (fourth grade).
4. Second grade students will view School House Rock Multiplication video (Appendix G) on a weekly basis to enhance pattern recognition while fourth grade students view the same video every other week to enhance multiplication skills (Dorough, B., 2002).

Project Action Plan

The action plan is to be implemented within the general education classrooms and music room as specified in the following outline. Research will be conducted over a nine-week period. Math is taught one hour per day in the general classroom. Music class is thirty minutes once weekly for the second grade students and twice weekly for the fourth grade students.

I. Week 1
   A. Send home permissions skips for participation in the research project.
   B. Collect permission slips.
   C. Send home the Parent Questionnaire.

II. Week 2
   A. Give student Questionnaire.
   B. Collect Parent Questionnaires.

C. Give pre-tests to participating second- and fourth-grade classes.

D. Begin Mozart music for 10 minutes daily as students arrive in both homeroom classes. The music teacher will also play Mozart as students enter the music room. This will continue throughout the entire intervention.

III. Week 3

A. Continue Mozart music.

B. Show School House Rock (S.H.R.) Multiplication Video to second- and fourth-grade classes.

C. The Music teacher introduces students to teacher-created songs for mathematical concepts listed in the study. Second grade students will learn "The Subtraction Song". Fourth grade students will learn "Geometric Shape Song".

IV. Week 4

A. Continue Mozart music.

B. Second grade class will view S.H.R. video again.

C. Music teacher will review teacher-created songs and introduce words and melodies for S.H.R. songs for both grades.

Two Elementary, My Dear
Three is a Magic Number
The Four-Legged Zoo
Five, Ready or Not, Here I Come
I got Six
Lucky Seven Sampson
Figure Eight
Naughty Number Nine
Zero, My Hero
Good Eleven
Little Twelvetoes

V. Week 5

A. Continue Mozart music.

B. Show School House Rock (S.H.R.) Multiplication Video to second- and fourth-grade classes.

C. Music teacher will review teacher-created and S.H.R. songs.

D. Music teacher introduces a 3-week unit on fractions using note values, Delcrose (strategy of syllables to represent note values) for division of beat, and fraction pies to show visual representation of the beat for second grade class.

E. Music teacher introduces a 3-week unit on geometric form for fourth grade using geometric shapes as icons to represent form in a song. Form is a concept showing repetition and change of patterns in sections of a song.

VI. Week 6

A. Continue Mozart music.

B. Second grade class will view S.H.R. video again.

C. Music teacher will review teacher-created songs and S.H.R. songs for both grades.

D. Music teacher continues with music unit. See Week 5. (Concept cannot be taught in one session.

VII. Week 7

A. Continue Mozart music.

B. Both classes will view S.H.R. video again.

C. Music teacher will review teacher-created songs and S.H.R. songs for both grades.

D. Music teacher continues with music unit. Concept is repeated and layered until comprehension is reached.

VIII. Week 8

A. Continue Mozart music.

B. Second grade class will view S.H.R. video again.

C. Cited music classes will perform teacher-created and S.H.R. songs for an audience.

D. Music teacher will review concepts and give assessment.

E. Second- and fourth-grade teachers give post-tests.

Methods of Assessment

The student questionnaire was designed to establish whether the students like or dislike math and math-related activities. The researchers hope to show that likes and dislikes of math will affect student math achievement. The questionnaire will be given to students in the first week of school. The second grade students will have the questions read to them by the teacher. Fourth-grade students will complete the questionnaire independently. The subject size will be 15 second-grade students and 18 fourth-grade students.

The subject size will be 15 second-grade students and 18 fourth-grade students. The cited students will be given the first test during the third week of school. Students will have 45 minutes to complete items on the test. Second-grade students will have the test read to them. The instrument used will be a teacher-made test. Answers on the first test are multiple-choice format. All students will record their answers on the actual test. All students will be tested on basic math achievement.

The subject size will be 15 second-grade students and 18 fourth-grade students. The second test will be given in the eighth week of school. Students will have 30 minutes to complete items on the test. The first part of the test for second grade students requires them to shade the correct sections to demonstrate fractions. The second part of the test is in true-false format. Fourth grade students will be tested on geometry and second grade students will be tested on the concept of fractions. The fourth grade students will be assessed using matching, short answer, multiple-choice, and drawing.

CHAPTER 4

PROJECT RESULTS

Historical Description of the Intervention

The problem posed by these researchers, was that the students in all grades at the cited school exhibited low math achievement resulting from reduction in general music classes for the district's students, as well as social and environmental reasons. The intervention of music activities implemented was created to meet project objectives and raise student math achievement. Strategies included daily classroom exposure to Mozart (classical-style music), School House Rock videos, and weekly or bi-weekly participation in teacher-created songs in the music room.

Following the first week of preliminary data collection of the "Problem evidence" as discussed in the previous chapter, the intervention was initiated on week two (September 3, 2002) and concluded on week nine (October 25, 2002). All strategies were repeated throughout the nine-week implementation period. Fourth grade students sang their teacher-created song, "Shapes", for their grade level twice weekly during music classes. Second-grade students sang their teacher-created song, "Addition Song", for their grade level once weekly during music classes. The music teacher demonstrated problems with two-digit subtraction using borrowing before, during, and after the weekly song. Each class for both grade levels lasted for thirty minutes in length. The fourth grade students requested to be allowed to put motions to their shape song, thus using Howard Gardner's multiple intelligences' bodily kinesthetic component.

The researchers encouraged a high level of involvement. The music teacher also put the geometrical shapes on the board while singing for the fourth grade students. For the full nine-week implementation period, students listened to Mozart music for approximately ten minutes as they entered the classroom in the morning and preceding math lessons. It was noted by the researcher of the second-grade students that following the completion of the study, student performance on daily assignments went down when the Mozart music was not being used.

School House Rock videos were shown for approximately 40 minutes per week to second-grade students. Fourth-grade students viewed the same video every other week for the same amount of time. Students enjoyed the video and were engaged by it.

Due to overwhelmingly positive test results, the researchers were so excited that they implemented strategies used in the study in their regular curriculum process up to Week 16, December 13, 2002. The principal also requested that the researchers continue the intervention because of increased scores on the district math test. The district arts coordinator was also interested in the positive results and asked for final findings. The coordinator requested that the researchers share results of the study with upper administration to justify increasing the contact time for the Arts in the cited district. This was the only in-house study of its kind in the district.

Presentation and Analysis of Results

Students were tested using teacher-made math assessments similar in design to the cited district quarterly assessments. A baseline score was recorded during Week one. After Week nine of the intervention, students were retested with the same teacher-made test. Second –grade students had a gain of 15.6 points (Figure 7) while fourth-grade students had a gain of 21 points (Figure 8).

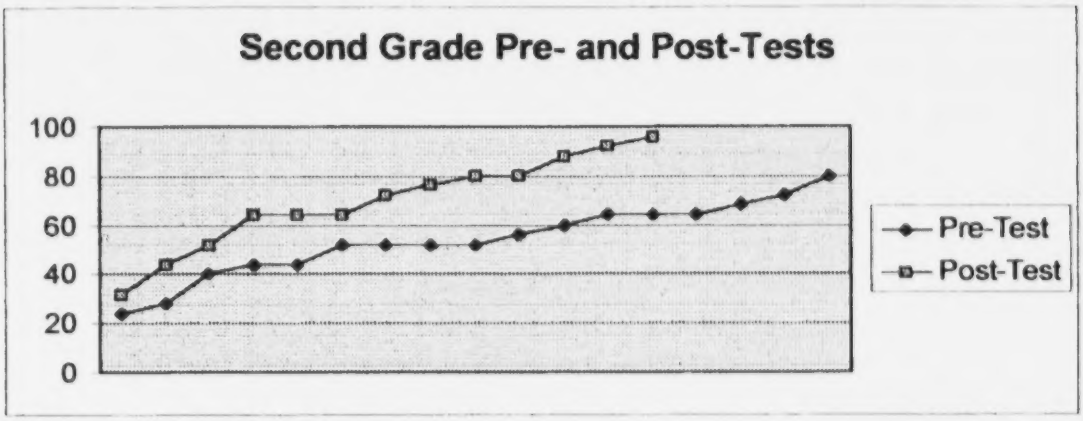

Figure 7. Comparison of pre-test and post-test of second-grade students.

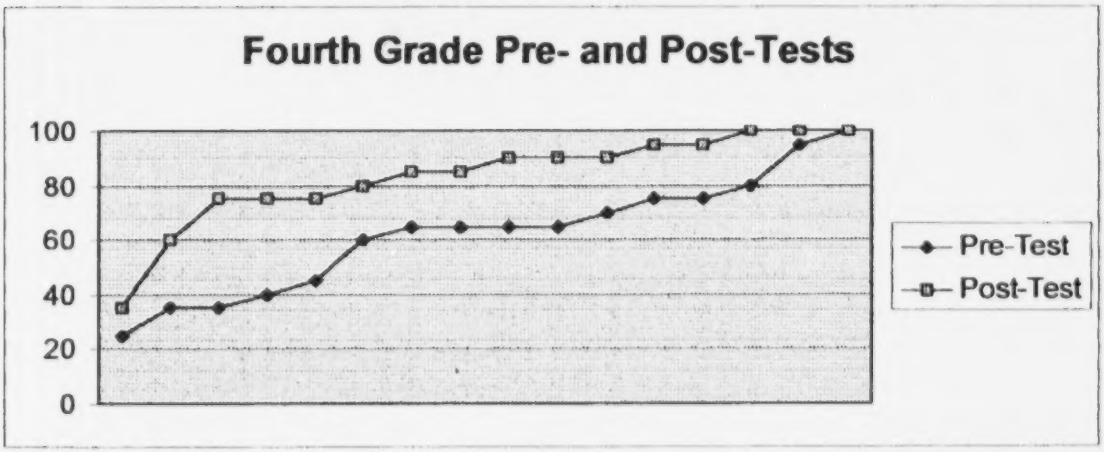

Figure 8. Comparison of pre-test and post-test of fourth-grade students.

After Week 16 of the intervention, students in both cited classes were once again retested using the same teacher-created assessment. The second-graders gained an additional 13.9 points (Figure 9), and the fourth graders gained another .5 point (Figure 10). The total gain of points for the cited classes was 21.5 for fourth-grade students and 29.5 for second-grade students. The mean for the second-grade students went from 53.9 during the pre-test to 69.6 during the post-

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test and finally 83.4 during the extension period. The mean for the fourth-grade students went from 62.1 in the pre-test to 83.1 during the post-test and 83.6 during the extension period.

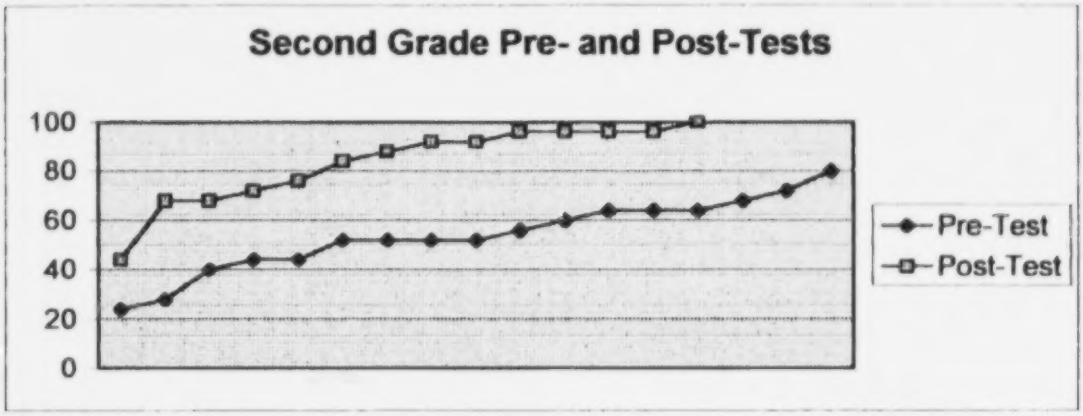

Figure 9. Comparison of pre-test and test given in Week 16 of second-grade students.

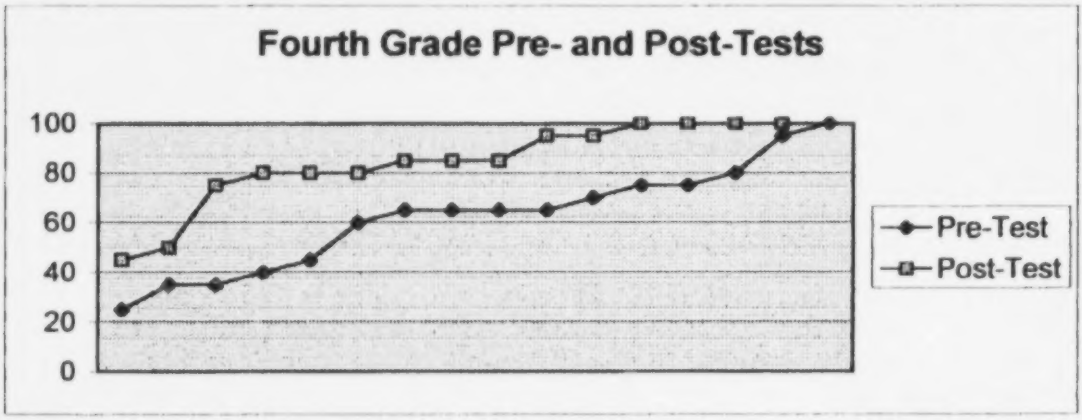

Figure 10. Comparison of pre-test and test given in Week 16 of fourth-grade students.

Conclusions and Recommendations

There is a definite correlation between math achievement scores and music. The researchers found students were able to retain information from the use of songs, and could make connections with fractions and patterning through note duration. The researchers noted that the fourth-grade group had a quicker increase in test scores than the second-grade group. This could be attributed to several factors.

The second-grade group required more repetition than the older group, possibly because of maturity levels. The second grade did increase, but not as significantly until the third test. The fourth grade group, overall, was higher from the beginning. The fourth grade pre-test had one 100% on the pre-test, which meant that improvement was not possible. By the second test, there were already three 100% scores, which could not be improved in the later test. The second-grade group gained slowly, but steadily. Another significant factor researchers noted was that the fourth-grade students had music 30 minutes twice weekly while the second-grade students had music only 30 minutes once weekly. It is possible that the increased music exposure caused the fourth-grade group to increase achievement at a quicker pace.

Mobility also affected the scores of the research. Both grades lost two students. The second-grade class lost higher-achieving students, while the fourth grade class lost one high- and one low-achieving student. One of the fourth-grade students was nearing completion of designation as a learning disabled student.

Both classes had mentally impaired or learning disabled students. At first, we felt that these students would negatively affect the outcome of the research, but the researchers decided to include these students in the study. Upon completion of the research, the researchers jointly agreed that the study was actually better because these students were included. These particular students especially needed music and repetition in order to increase math achievement. Without music, these students normally made slow gains in achievement. Researchers believe that these students could have achieved even higher scores had formal music instruction been part of their daily instruction. District quarterly assessment scores for each grade level improved each quarter as well.

The researchers would make the following recommendations to anyone who wanted to try this intervention:

A. Follow the Action Plan as stated.

B. Continue the Action Plan from beginning to end of the school year.

C. Create or use more mathematical icons to cover various other skills.

D. Consider making copies of Mozart's music and teacher-created math songs to send home with students. Ask parents to expose their children to the music provided whenever possible.

Given our changing global world, there is a great need for students to achieve in the area of mathematics. Our students come to us with the intelligence they are born with and a trunk full of positive and negative memories and experiences. Some areas, such as that of the cited school, have more disadvantages than other areas. Our job as educators is to do whatever possible, physically or mentally, to reach all levels of children. Music is an area of our culture, emotion, and human need that unlocks the mind and allows for growth of all students, even in the most disadvantaged and learning-disabled children.

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APPENDICES

Appendix A
Second-Grade Test

Student Number _____
Date _____
Teacher Name _____

Grade 2
Quarter 1

Your teacher will read all items. Color the oval with the correct answer.

1. Continue
   23, 24, 25
   - O 26, 27, 28
   - O 21, 22, 23
   - O 33, 34, 35
   - O 36, 37, 38

2. Continue
   143,142,141
   - O 140, 141, 142
   - O 142, 143, 144
   - O 140, 139, 138
   - O 139, 138, 137

3. Continue
   697, 698, 699
   - O 500, 501, 502
   - O 700, 701, 702
   - O 998, 999, 1000
   - O 600, 601, 602

4. Which numbers are in order from smallest to largest?
   - O 28, 36, 45
   - O 50, 70, 30
   - O 42, 47, 39
   - O 16,18,14

5. Which numbers are in order from smallest to largest?
   - O 72, 69, 64
   - O 10, 12, 8
   - O 2, 19, 65
   - O 60, 58, 65

6. Which answer has even numbers?
   - O 20, 25, 30, 35
   - O 12, 15, 18, 21
   - O 12, 14, 16, 18
   - O 3, 7, 14, 21

Student Number _____
Date _____
Teacher Name _____

7. Are there odd or even spots?

O even

O odd

8. Is the number 19 odd or even?

O even

O odd

9. Which number has

0 in the ones place
7 in the hundreds place
5 in the tens place

O 705
O 750
O 570
O 507

10. Which number has

6 in the ones place
9 in the hundreds place
8 in the tens place

O 698
O 968
O 986
O 896

11. How many hundreds in: 314

O 3
O 1
O 4
O 0

12. How many tens in: 314

O 3
O 1
O 4
O 0

Student Number _____
Date _____
Teacher Name _____

13. How many ones in: 314

- O 3
- O 1
- O 4
- O 0

14. There are 26 girls and 33 boys in the After School Program. How many altogether?

- O 7 children
- O 59 children
- O 69 children
- O 49 children

15. There are 42 steaks at the store. A dog grabbed 2 of them. How many are left?

- O 30 steaks
- O 40 steaks
- O 44 steaks
- O 38 steaks

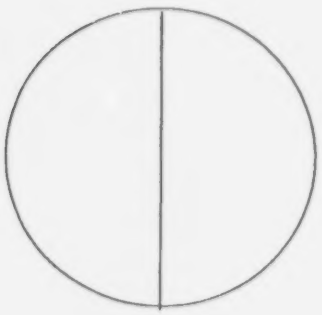
Grading Scale

14-15 = A
12-13 = B
11 = C
9-10 = D
0-8 = Not Yet

Total Points _____
Possible Points 15

1-6. Shade in the area(s) that is the same as the fraction given. (10 points each)

Name _____
Date _____
Teacher _____



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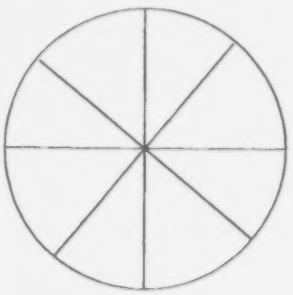
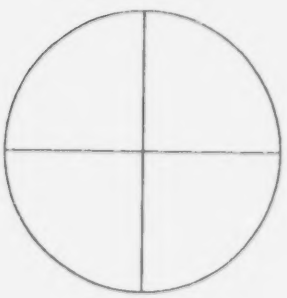


$\frac{3}{8}$



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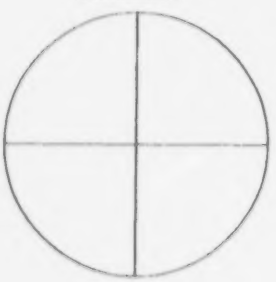

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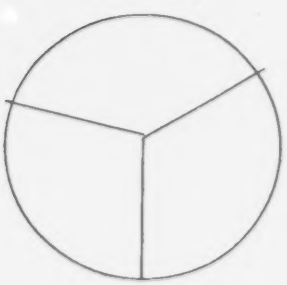

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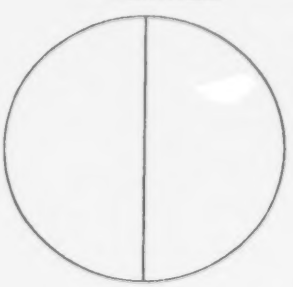


$\frac{2}{2}$

Name _____
Date _____
Teacher _____

Write T if the statement is true and F if the statement is false. (10 points each)

7. _____ The top number is called the numerator.

8. _____ The bottom is the number of shaded parts.

9. _____ The bottom number is called the denominator.

10._____ If the bottom number and the top number are the same, the fraction equals one.

Grading Scale

90-100 = A
80-89 = B
70-79 = C
60-69 = D
0-59 = F

Appendix B
Fourth-Grade Test

Student Number _____
Date _____
Teacher Name _____

Grade 4
Test 1
Color the oval with the correct answer. (5 points each)

1. Look at the following number: 263,197

   The 1 stands for

   - O hundreds
   - O thousands
   - O ten-thousands
   - O hundred-thousands

2. Look at the following number: 792,865

   The 5 stands for

   - O hundreds
   - O ones
   - O ten-thousands
   - O hundred-thousands

3. Look at the following number: 792,865

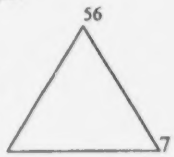
   The 7 stands for

   - O hundreds
   - O ones
   - O ten-thousands
   - O hundred-thousands

4. Which is the smallest number?

   - O 18,000
   - O 10,080
   - O 10,008
   - O 10,800

5. What is the missing number in the fact triangle?

   - O 6
   - O 5
   - O 7
   - O 8

6. Give the answer for:

   25 * 20

   - O 70
   - O 60
   - O 600
   - O 500

Student Number _____
Date _____
Teacher Name _____

7. Which one is true?

- O 9,173 < 9,731
- O 9,713 =.9,173
- O 9,713 < 9,173
- O 9,137 = 9,731

8. Which number makes the sentence true?

4 * _____ > 20

- O 2
- O 3
- O 4
- O 9

9. Which number makes the sentence true?

6 * _____ < 20

- O 2
- O 4
- O 5
- O 15

10. Which number makes the sentence true?

7 * _____ < 70

- O 9
- O 10
- O 11
- O 72

11. Finish the sentence.

6 * n = 36 n = _____

- O 6
- O 5
- O 82
- O 196

12. Finish the sentence.

n + 15 = 25 n = _____

- O 25
- O 55
- O 10
- O 450

Student Number _____
Date _____
Teacher Name _____

13. Finish the sentence.

$5 * 5 = 50 - n \quad n = ____$

- O 21
- O 20
- O 25
- O 50

14. The cost of 8 pieces of candy at a nickel each is ___.

- O $.15
- O $.90
- O $.40
- O $1.50

15. Answer.

$ .41
+ .34

- O $ .64
- O $ .75
- O $ .84
- O $ .22

16. Answer.

$1.72
+$2.83

- O $3.54
- O $3.55
- O $4.65
- O $4.55

17. Draw a parallelogram.

18. Draw a equilateral triangle.

Student Number _____
Date _____
Teacher Name _____

19. Draw a trapezoid.

20. Draw a circle.

Grading Scale

90-100 = A
80-89 = B
70-79 = C
60-69 = D
Below 59 = F

Total Points _____
Possible Points 100

Appendix C
Parent Questionnaire

Student Number _____
Date _____

Parent Questionnaire

1. Circle the highest level of math completed.

   Addition/Subtraction
   Multiplication/Division
   Algebra
   Geometry
   Trigonometry
   Calculus

2. Circle the highest level of math that you would feel comfortable helping your child.

   Addition/Subtraction
   Multiplication/Division
   Algebra
   Geometry
   Trigonometry
   Calculus

3. Do you practice math facts at least twice weekly with your child? Yes No

4. Would you be interested in attending math workshops that would help you teach your child? Yes No

5. Did you enjoy math while you were in school? Yes No

6. Do you help your child with his/her math homework? Yes No

7. Do you play with or buy math games for your child? Yes No

8. Can your child tell time on a face clock? Yes No

Appendix D
Student Questionnaire

Student Number____

Student Questionnaire

1. Do you like math?	Yes or No
2. Do you like playing math games?	Yes or No
3. Do you practice math facts at home?	Yes or No
4. Do you like making designs with shapes?	Yes or No
5. Do you know how to count change?	Yes or No

Appendix E
Teacher-Made Second-Grade Song

The Subtraction Song
(Song to the tune of "I'm a Woman")

Verse 1

I can take from the tens, da da da.
Add on to the ones, da da-da da da.
Subtracting from the ones column is so much fun.

'Cause I'm subtraction,
And I'm so much fun.
Move on from the ones.

Verse 2

I can borrow from hundreds, da da da.
Add it on to the tens, da, da-da, da.
Subtract from the tens column.
Boy, it's so much fun!

And I'm subtracting,
Just like the older kids do.
And I'm subtracting, **(Second time, go to Coda)**
Hey, Mom, I learned something new.

Repeat verse 1 and 2.

Coda – last line

Hey, Principal, "We learned something cool!"

Appendix F
Teacher-Made Fourth-Grade Song

Geometric Shape Song
(Song to the tune of "Dry Bones")

A triangle has three sides.
A triangle has three sides.
A triangle has three sides.
One two three, boom boom boom.

A quadrangle has four sides.
A quadrangle has four sides.
A quadrangle has four sides.
One two three four, yah, boom boom boom.

A pentagon has five sides.
A pentagon has five sides.
A pentagon has five sides.
One two three four five, boom boom boom.

A hexagon has six sides.
A hexagon has six sides.
A hexagon has six sides.
One two three four five six (triplets), yah, boom boom boom.

A circle has no sides.
A circle has no sides.
A circle has no sides.
It has no side, boom boom boom.

Geometric figures.
Geometric figures.
Geometric figures are so much fun.

Those shapes, those shapes are gonna move around.
Those shapes, those shapes are gonna move around.
Those shapes, those shapes are gonna move around.
My teacher says so.

Appendix G
School House Rock Lyrics

Schoolhouse Rock - Multiplication Rock

Zero, My Hero

Music & Lyrics: Bob Dorough
Sung by: Bob Dorough
Animation: Focus Design, Inc.

}} {Zero?}
{Yeah. Zero is a wonderful thing. In fact, zero is my hero.}
}} {How can zero be a hero?}
{Well, there are all kinds of heroes, you know.
A man can get to be a hero for a famous battle he fought.
Or by studying very hard and becoming a weightless astronaut.
And then there are heroes of other sorts,
Like the heroes we know from watching sports.
But a hero doesn't have to be a grown up person, you know.
A hero can be a very big dog who comes to your rescue.
Or a very little boy who's smart enough to know what to do.
But let me tell you about my *favorite* hero...}

My hero, zero.
Such a funny little hero,
But till you came along, we counted on our fingers and toes.
Now you're here to stay,
And nobody really knows
How wonderful you are,
Why we could never reach a star,
Without you zero, my hero,
How wonderful you are.

}} {What's so wonderful about a zero? It's nothing, isn't it?}
{Sure, it represents nothing alone.}

But place a zero after 1
And you've got yourself a 10.
See how important that is?
When you run out of digits,
You can start all over again.
See how convenient that is?
That's why, with only ten digits, including zero,
You could count as high as you could ever go...
Forever, towards infinity...
No one ever gets there, but you could try.

10 billion zeros,
From the cavemen till the heroes who invented you,
They counted on their fingers and toes
{And maybe some sticks and stones}
}} {Or rocks and bones}
{And their neighbors' toes, yeah}

And nobody really knows
How wonderful you are,
Why we could never reach the star,

BEST COPY AVAILABLE

Place one zero after any number,
And you've multiplied that number by 10.
See how easy that is?
Place two zeros after any number,
And you've multiplied that number by 100.
See how simple that is?
Place three zeros after any number,
And you've multiplied that number by 1000.
Et cetera, et cetera.
Ad infinitum, ad astra, forever, and ever,
With zero, my hero, how wonderful you are!

Schoolhouse Rock - Multiplication Rock

Two Elementary, My Dear

Music & Lyrics: Bob Dorough
Sung by: Bob Dorough
Animation: Paul Kimmelman and Associates

Forty days and forty nights, didn't it rain, children?
Not a speck of land in sight }} Didn't it, didn't it rain?
But Noah built the ark so tight, they sailed on, children.
And when at last the waters receded,
And the dove brought back the olive tree leaf,
He landed that ship near Mount Ararat.
And one of his children grabbed Noah's robe and said...
}} {Hey Dad, how many animals on this old ark, anyway, huh?}

Elementary, my dear, two time two is four.
Elementary, my dear, two time three is six.
Elementary, my dear, two time four is eight.
Elementary, my dear, two time five is ten.

Two times one is two, of course, and it must occur to you,
You get an even number every time you multiply by two.

Elementary, my dear, two time six is twelve.
Elementary, my dear, two time seven is fourteen.
Elementary, my dear, two times eight is sixteen.
Elementary, my dear, two times nine is eighteen.

Two times ten is twenty; eleven twice is twenty-two.
Double twelve that's twenty-four; thirteen twice is twenty-six.
Fourteen twice is twenty-eight; fifteen twice is thirty.
Now you build it up on thirty.

Sixteen twice is thirty-two, elementary.
Seventeen twice is thirty-four, elementary.
Eighteen twice is thirty-six, elementary.
Nineteen twice is thirty-eight, elementary.

Twenty twice is forty, and it must occur to you,
You can double any number, all you do is multiply by two.

Elementary, my dear, two time two is four. Woo!
Elementary, my dear, two time three is six. Yeah.
Elementary, my dear, two time four is eight. Woo!
Elementary, my dear, two time five is ten. Yeah.

{Now, if you want to multiply two times 174, or some big number like that... Two times 174 equals two times 100 plus two times 70 plus two times 4, that's all. So two times 174 equals 200 plus 140 plus 8, or, 348. It's elementary!}

Elementary... elementary...

Yeah, yes! It's elementary, yeah....

{Now, what's two times 98?}
}) {Aww, that's hard!}
{No, it's very simple. Two times 98 equals two times a hundred,
minus two times two. That's 200 minus four: 196. Elementary.}

Forty days and forty nights, didn't it rain, children?

Schoolhouse Rock - Multiplication Rock

Three is a Magic Number

Music & Lyrics: Bob Dorough
Sung by: Bob Dorough
Animation: Focus Design, Inc.

Three is a magic number.
Yes it is, it's a magic number.
Somewhere in the ancient, mystic trinity
You get three as a magic number.
The past and the present and the future,
Faith and hope and charity,
The heart and the brain and the body
Give you three.
That's a magic number.

It takes three legs to make a tri-pod or to make a table stand.
It takes three wheels to make a ve-hicle called a tricycle.
Every triangle has three corners,
Every triangle has three sides,
No more, no less.
You don't have to guess.
When it's three you can see it's a magic number.

A man and a woman had a little baby.
Yes, they did.
They had three in the family.
That's a magic number.

3, 6, 9... 12, 15, 18... 21, 24, 27... 30.
3, 6, 9... 12, 15, 18... 21, 24, 27... 30.

}} {Multiply backwards from three times ten.}

Three time ten is... }} 30
Three times nine is... }} 27
Three times eight is... }} 24
Three times seven is... }} 21
Three times six is 18, three times five is 15
Three times four is twelve
And three times three is nine and three times two is six.
And three times one is three of course.

}} {Now take the pattern once more.}
}} {Three!}
3, 6, 9.
}} {Twelve.}
12, 15, 18.
}} {Twenty-one.}
21, 24, 27... 30.

}} {Now multiply from 10 backwards.}

BEST COPY AVAILABLE

Three times eight is... }} 24
Three times seven is... }} 21
Three times six is 18, three times five is 15,
Three times four is twelve
And three times three is nine and three times two is six.
And three times one... {What is it?}
}} {Three!}
{Yeah} That's a magic number.

A man and a woman had a little baby.
Yes, they did.
They had three in the family.
That's a magic number.

Schoolhouse Rock - Multiplication Rock

The Four-Legged Zoo

Music & Lyrics: Bob Dorough
Sung by: Bob Dorough
Animation: Paul Kimmelman and Associates

We went to the four-legged zoo,
To visit our four-footed friends.
}} Lions and tigers, cats and dogs,
}} A goat and a cow and a couple of hogs
A rhinoceros and of course a hippopotamus,
And, oh yes, a horse.

}} An elk and a bison and a gnu or two,
}} Giraffes and elephants, quite a few.
A llama, alpaca, vicuna too,
Zebras, xebexes, and one big kudu.
It was swell! }} {I liked the gazelles!}

}} {Now Miss Simpson said...}
}} {She teaches school, you know.}
}} {Yeah, she took us there!}
}} {Well Miss Simpson said...}
}} {If you counted every head on these quadripeds,
}} then multiplied that number by four,
}} We'd know how many feet went through the door
}} If we turned 'em all loose!}
}} {Oh no, don't do that!}
}} {It's a really groovy zoo.}
}} {But, anyway, what Miss Simpson said,
}} It was a good chance to work with our fours in our head.
}} One, two, three, four!}

I'll take a lion... }} One times four
He's got four legs and maybe a roar.
}} Gimme two camels, that's two times four
}} Eight legs walking 'cross the desert floor.

A tiger and a lamb and a fat kudu
We got three times four }} Equals 12 %legs too%
But then I had to subtract when that tiger was through... Rowwwr!

Four four-footed friends, no matter who
Would have 16 legs, And it's always true...
}} That four times four equals 16.
}} Five times four is 20.

{Now a coach and six, if you were Cinderella, would have you home
by midnight, if those 24 legs ran fast as lightning...}
}} Six times four equals 24...
}} Seven times four equals 28...
Anyone knows that, who cares about seven.

BEST COPY AVAILABLE

Here come a small herd of buffalo,
They say they're gettin' extinct, y'know.
}} I can count nine, that's 36 legs, Nine times four equals 36.
}} Here comes a baby buffalo.
That's good! That's ten.
And ten times four, y'know, is 40....

Eleven coyotes }} Eleven times four,
Went slinking over the prairie floor on all of their legs...
}} Equals 44.

Now twelve times four is as high as we go...
}} Twelve times four equals 48.
But there were so very very many many more
Animals standing there by the gate.

But we'd have to use a pencil if we counted them all
And we really had fun, and we saw every one:
}} A bear, a cougar, a jackal, a yak,
}} A fox, some deer, and a sweet giraffe

But I can't remember how many, many more,
But we multiplied them all by four.
And some of them thanked us with a roar.

Schoolhouse Rock - Multiplication Rock

Five, Ready or Not, Here I Come

Music & Lyrics: Bob Dorough
Sung by: Bob Dorough
Animation: Paul Kimmelman and Associates

{Now everybody try to find a good hiding place.
This old tree is gonna be the base.
I'm gonna close my eyes, and hide my face,
And count to a hundred by fives.
Ready, go!}

5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80,
85, 90, 95, 100, ready or not, here I come.

Apples, peaches, pumpkin pie,
Who's not ready, haller "Aye"... }} {Aye!}
{Aw, alright, I'll count it again, but ya better get hid, kid.
Here we go:}

5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80,
85, 90, 95, 100, 105, 110, 115, 120. {There.}

A bushel o' wheat, and a bushel o' rye,
Who's not hid, haller "Aye"....
Twenty nickels makes a dollar.
I didn't hear any anybody haller.
Five times twenty is one hundred,
Everybody got to be hid.
All eyes open, here I come. Woo!

{Multiplying by five is a little like countin' by five. In fact,
if you counted along on your fingers as you counted out loud by
fives, your fingers would tell you how many fives, you got.

Ok, let's count it together. Count on your fingers, one finger
for each count out loud. Get set, ready, go!}

5, 10, 15, 20...

{Stop! 20. You got four fingers, see, that means four times five
is 20. Let's try another one. Get set, ready, go!}

5, 10, 15, 20, 25, 30, 35...

{Stop! 35. Seven fingers, that's right, seven times five is 35.
Okay, let's try a longer one. Now when you run out of fingers, at
50, you see, because ten times five is 50, then start over with the
same fingers and remember that you owe 10. Get set, ready, go.}

5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60...

{Stop! Ten and two, right? That's twelve fingers, 12 times five

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Now you may notice that if you multiply five by an even number, your product will end in zero, and if you multiply five by an odd number, your product will end in five.

Ok, now let's do one more game of counting by fives on our fingers. This is a long one. Keep going. Get set, ready, go!}

5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85...

{Stop! 85 -- seventeen fingers.
Look at that boy with 17 fingers stickin' up. How d'ya do that, kid? Anyway, five times 17 *is* 85.

See, that's three fives short of a hundred. If you had three more nickels, 15 cents, then added the 15 to the 85, you'd get a hundred. Right?}

Cause five times 20 is 100,
Everybody gotta be hid, it's...

5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100. Ready or not -- here I come!

Schoolhouse Rock - Multiplication Rock

I Got Six

Music & Lyrics: Bob Dorough
Sung by: Grady Tate
Animation: Paul Kimmelman and Associates

I got six, that's all there is.
}} Six time one is six; one times six.

He got six. I put mine with his, and we got twelve.
}} Six time two is twelve; two times six.

I got six, you got six, she got six.
{We got eighteen altogether, if we can get 'em all together.}
}} Six time three is eighteen; three times six.

I got six in my right hand, six in my left hand, six on my head.
{You got six in your pocket. Put 'em all on the floor, that's 24.}
}} Six time four is 24; four times six.

I got six red hens, they laid five eggs each.
{All the eggs hatched out and the yard was full of 30 little chicks.}
}} Six time five is 30; five times six.

One fine day, they all started in to lay.
{I got 36 eggs, and I took 'em in the house, and I put 'em in boxes.
Six eggs each, six boxes.}
}} Oh, six times six is 36; six times six.

{Goin' to the candy store...
I'll take six of these, and six of those,
And six of them, and six of the others.
And also six of the red, six of the white, and six of the blue.
Put 'em in one bag, that's 42.}
}} Six times seven is 42;
Seven times six.

}} Oh, goin' downtown, pickin' up sticks!
}} I made 8 tricks, and didn't miss a lick.
Six times eight is 48; eight times six.

Nine hungry men had six dollars each. }}Awwh!
{That's 54 bucks, but they were outta luck,
'Cause 54 bucks won't buy dinner downtown, not for nine.}
Then there were six hungry men, they had nine dollars each. }}Yeah!
{And they went downtown, and the waiter said "Sit down,"
For it makes a big difference how you spread it around.}
}} Six time nine is 54; nine times six.

See that prince over there? }}Yeah!
The one with the fuzzy hair.
{He got six rings on every finger.
He don't wash no dishes, not with 60 diamonds.}

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He brought along eleven camels, ain't that nice? }}Ain't that nice?
{Each one loaded down with six casks of oil and spice.
Brought quite a price.}
}} Six time eleven is 66; eleven times six.

He had twelve wives, he better be rich!
{Each one had six kids, six children each.}
}} Six time twelve is 72; twelve times six.

But me, I got six. }} I got six!
That's all there is. }} That's all there is!
Six times one is six; one times six.
I got six! }} I got six!
That's all there is. }} That's all there is!

Schoolhouse Rock - Multiplication Rock

Lucky Seven Sampson

Music & Lyrics: Bob Dorough
Sung by: Bob Dorough
Animation: Paul Kimmelman and Associates

Now you can call me Lucky 'cause Lucky's my name,
Singin' and dancin', that's my game.
I never did a whole day's work in my life,
Still everything seems to turn out right.
Like a grasshopper on a summer's day,
I guess I love to play, and pass the time away.
'Cause I was born 'neath a lucky star!

{They said I'd go far...}

Makin' people happy, that's my favorite game,
Lucky Seven is my natural name.
Slippin' and slidin' my whole life through
Still I get everything done that I got to do.
'Cause I was born 'neath a lucky star!

{School is where you are? Aww, that's not hard, lemme show ya
something.}

You multiply seven time one,
I got seven days to get that problem done.
Multiply seven time two,
Take 14 laughs when you're feelin' blue.
Multiply seven time three,
A 21-day vacation, you can play with me.
Multiply seven time four,
You got 28 days, that's-a one month more,
To pay the mortgage on your store, don't worry!

{Somethin'll turn up, yeah!}

Multiply seven time five,
I don't know how you did it, but man alive, that's 35.
Multiply seven time six,
Grab a stick and make-a 42 clickety-clicks.
Multiply seven time seven,
Take 49 steps right up to seventh heaven.
Multiply seven time eight,
They got 56 flavors and I just can't wait...
Multiply seven time nine,
63 musicians, all friends of mine.
Multiply seven time ten,
And that brings you right back to 70 again.

{You know, I think that's important, there's a trick there
somewhere...}

Multiply seven time twelve,
You got 84, and isn't that swell.
I'm gonna try seven times 13 just for fun:
70 plus 21.
Seven times 14 must be great,
Well, exactly that's-a 70 plus 28.
Seven times 15, man alive,
That's 70 plus 35, a hundred and five!

{Man, this stuff is simple, no jive, you got it! Now I gotta fly.
'Scuse me folks, I'm sayin' goodbye,
I sure do thank you for the huckleberry pie.
Take it home, boys!}

Remember Lucky Seven Samson, that's my natural born name,
If you should ask me again, I'll have to tell you the same.
You'll wake up tomorrow, you'll be glad that I came,
'Cause you'll be singin one of the songs that I sang.

So keep a happy outlook and be good to your friend,
And maybe I'll pass this way again!

{Maybe... Bye!}

Schoolhouse Rock - Multiplication Rock

Figure Eight

Music & Lyrics: Bob Dorough
Sung by: Blossom Dearie
Animation: Paul Kimmelman and Associates

Figure eight, as double four.
Figure four, as half of eight.
If you skate, you would be great,
If you could make a figure eight.
That's a circle that turns 'round upon itself.

One times eight is two times four.
Four times four is two times eight.
If you skate upon thin ice,
You'd be wise, if you looked twice
Before you made another single move.

One times eight is eight, two times eight is 16
Three times eight is 24, four times eight is 32
And five times eight is 40, you know.

Six times eight is 48, seven times eight is 56,
Eight times eight is 64, nine times eight is 72,
And ten times eight is 80, that's true.

Eleven times eight is 88, and twelve times eight is 96.
Now here's a chance to get off on your new math tricks:
'Cause twelve times eight is the same as ten times eight
Plus two times eight:
(80 plus 16, ninety-six!)

One times eight is eight, two times eight is 16
Three times eight is 24, four times eight is 32
And five times eight is 40, you know.

Figure eight, as double four.
Figure four, as half of eight.
If you skate, you would be great,
If you could make a figure eight.
That's a circle that turns 'round upon itself.

Place it on its side and it's a symbol meaning infinity.

Schoolhouse Rock - Multiplication Rock

Naughty Number Nine

Music & Lyrics: Bob Dorough
Sung by: Grady Tate
Animation: Paul Kimmelman and Associates

Number nine will put you on the spot.
Number nine will tie you up in a knot.
When you're trying, multiplyin' by nine
You might give it everything you got
And still be stopped.

If you don't know some secret
Way you can check on,
You'll break your neck on
Naughty number nine.

{Now the first thing to keep in mind,
When you're multiplying by nine
Is that it's one less than ten.
You see, nine is the same as ten minus one.
So you could multiply your number by ten
And then subtract the number from the result,
And you'd get the same product as if you'd multiplied by nine,
And you knew it.

I mean, eight times nine is 80 minus eight,
And seven times nine is 70 minus seven,
And six times nine is 60 minus six.
You could use those tricks.}

Cause you must have some secret
Way you can beat it,
Or else you'll %need it%
With naughty number nine.

{Of course, it doesn't hurt to know the table of nines by memory.
It goes like this:}

One times nine is nine, and two times nine is 18.
Mean ol' number nine.
Three times nine is 27, and four times nine is 36.
Five times nine is 45, and six times nine is 54,
And seven times nine is 63.
Eight times nine is 72, and nine times nine is 81,
And ten times nine is 90.

{Now the digit sum is always equal to nine.
I mean, if you add two and seven, the digits, you get nine:
the digit sum. That's true of any product of nine.
If they don't add up, you've made a mistake.}

'Cause you must have some secret way you can check it

Schoolhouse Rock - Multiplication Rock

The Good Eleven

Music & Lyrics: Bob Dorough
Sung by: Bob Dorough

Good, good, good, good... the good eleven
It's almost as easy as multiplying by one.
Good, good, good, good eleven
Yes, eleven almost makes multiplication fun.

Some people get up at a quarter till seven
Other people I've met, till 8:45 or nine.
But I'm happy just a-hanging there till eleven.
Cause eleven has always been a friend of mine.

Good, good, good, good eleven
Never gave me any trouble till after nine.
Good, good, good, good eleven
Eleven will always be a friend of mine.

Now when you get a change to multiply by eleven,
It's almost as easy as multiplying by one.
You don't even have to use a pencil when you use eleven.
And eleven almost makes multiplication fun.
You know why?

Because you get those funny-looking double-digit-doojies as an answer.
Like 22, 33, 44 and 55.
66, 77, 88, and 99 is your answer
When you multiply 11 by 2, 3, 4, 5, 6, 7, 8 and 9.

Good, good, good, good eleven
Never gave me any trouble till after nine.
Good, good, good, good eleven
I can always get the answer easy every time.

Now eleven times ten is the same is ten times eleven.
It's 110, no matter what you do.
And 121 is the answer to eleven times eleven.
And eleven times twelve is 132.

Eleven thirteens are 143 now (that's-a 1-4-3).
Eleven fourteens are 154 (dig it, that's 1-5-4),
1-6-5 and 1-7-6 are fifteen and sixteen.
You'd better pick up on the latter 'cause I ain't got time to tell you
any more.

I've got a date with the good eleven...
She never gave me any trouble till after nine.
Good, good, good, good eleven
Yes, eleven will always be a friend of mine!

Schoolhouse Rock - Multiplication Rock

Little Twelvetoes

Music & Lyrics: Bob Dorough
Sung by: Bob Dorough

Now if man had been born with 6 fingers on each hand, he'd also have 12 toes or so the theory goes. Well, with twelve digits, I mean fingers, he probably would have invented two more digits when he invented his number system. Then, if he saved the zero for the end, he could count and multiply by twelve just as easily as you and I do by ten.

Now if man had been born with 6 fingers on each hand, he'd probably count: one, two, three, four, five, six, seven, eight, nine, dek, el, doh. "Dek" and "el" being two entirely new signs meaning ten and eleven. Single digits! And his twelve, "doh", would be written 1-0. Get it? That'd be swell, for multiplying by 12.

Hey little twelvetoes, I hope you're well.
Must be some far-flung planet where you dwell.
If we were together, you could be my cousin,
Down here we call it a dozen.
Hey little twelvetoes, please come back home.

Now if man had been born with 6 fingers on each hand, his children would have 'em too. And when they played hide-and-go-seek they'd count by sixes fast. And when they studied piano, they'd do their six-finger exercises. And when they went to school, they'd learn the golden rule, and how to multiply by twelve easy: just put down a zero. But me, I have to learn it the hard way.

Lemme see now:
One times 12 is twelve, two times 12 is 24.
Three times 12 is 36, four times 12 is 48, five times 12 is 60.
Six times 12 is 72, seven times 12 is 84.
Eight times 12 is 96, nine times 12 is 108, ten times 12 is 120.
Eleven times 12 is 132, and 12 times 12 is 144. WOW!

Hey little twelvetoes, I hope you're thriving.
Some of us ten-toed folks are still surviving.
If you help me with my twelves, I'll help you with your tens.
And we could all be friends.
Little twelvetoes, please come back home.

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Organization/Address: Saint Xavier University, 3700 W. 103rd St. Chgo, IL	Telephone: 708-802-6219 FAX: 708-802-6208
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